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Project Summary

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Hematologic and Immunologic Studies of Humans Exposed to SO_2

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Immunologic and hematologic parameters were used to evaluate the effects in humans of a single 2 hour exposure to either clean air or 0.75 ppm SO_2. Venous blood samples were obtained before, immediately after, and 24, 48, and 72 hours following the end of exposure. Parameters studied included complete blood counts, enumeration of lymphocyte populations using surface membrane receptor markers, evaluation of lymphocyte mitogen stimulated response, and concentration of secretory immunoglobulin A (s-IgA) content of nasal washings.

No statistically significant changes were seen in s-IgA, blood erythrocytes or immunologic parameters examined. A possibly significant decrease was found in monocyte 48 hours following SO_2 exposure, but this recovered after 72 hours. A stimulatory effect (not statistically significant) was noted at 48 and 72 hours post-SO_2 in s-IgA and in lymphocyte numbers bearing receptors for the Fc portion of IgG, while a decrease occurred in active T-lymphocytes with receptors for sheep red blood cells.

This Project Summary was developed by EPA's Health Effects Research Laboratory, Research Triangle Park, NC, to announce key findings of the research report that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

Twenty-eight healthy, non-smoking, male volunteers between the ages of 19 and 27 were studied after informed consent was obtained. They completed a comprehensive medical questionnaire and were examined by a physician. Exposures to 0.75 ppm SO_2 or clean air took place in an airtight chamber with a relative humidity of 60% and temperature at 22.2°C. Subjects rested during the 2 hour exposure, except for a single 15 min. exercise period on a treadmill at 4 mph with a grade of 10% that began 45 min. into the exposure.

Venous blood samples were taken prior to, and immediately following each exposure and again at 24, 48, and 72 hours post-exposure. All samples were processed immediately following collection.

The hematologic analyses included red blood cell (RBC) and white blood cell (WBC) counts, hematocrit (HCT), mean cell volume (MCV), hemoglobin (Hgb), and cell differential on stained blood smears.

The effect of SO_2 on cellular immunity was determined by the characteristics of membrane receptors (rosette formation) and by the mitogenic *in vitro* responsiveness (transformation) of lymphocytes.

The s-IgA content of nasal washings was quantitated by immuno fluorescent methods.

There was no significant difference between the air and the SO_2 group means in the RBC counts, cell differ-

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ential, or the associated parameters (MCV, Hct, Hgb) at any of the four post-exposure sampling times. A possibly significant decrease was found in the percentage of monocytes in the SO_2 group compared to controls at 48 hours post-exposure ($p = 0.005$; $4.8 \pm 0.5\%$). This change paralleled a progressively decreasing mean total WBC count which was decreased to $5481 \pm 367/mm^3$ at 48 hours from $6025 \pm 382/mm^3$ at 0 hour. Both the leukocyte and the monocyte values had slightly recovered in samples taken at 72 hours post-SO_2 exposure. It may also be noted that at 48 hours the percentage of lymphocytes was increased in the SO_2 group ($34.2 \pm 1.4\%$ at 0 hour; $37.1 \pm 1.5\%$ at 48 hours).

Lymphocyte transformation included data from only 6 subjects in the air group and 4 subjects in the SO_2 group. No significant differences were found between the SO_2 and the air group means in the responsiveness of lymphocytes to phytohemagglutinin (PHA) or pokeweed mitogen (PWM).

The results of active T-lymphocyte numbers bearing membrane receptors for sheep erythrocytes (TEa rosettes) showed no significant differences between the means of the SO_2 and the air groups ($p = 0.746$), however, the TEa values in the SO_2 group continued to decrease after the exposure including the 72 hour sample (567 ± 75 at 0 hour; 417 ± 63 at 72 hours). In contrast, the mean TEa cell number for the air group showed a partial recovery at 72 hours.

No significant differences were found between the air and SO_2 group means in the lymphocytes bearing receptors for the Fc portion of IgG ($p = 0.227$). However, there was an increase in Fc cells at 48 and 72 hours in the SO_2 group (363 ± 42 at 0 hour; 411 ± 45 at 48 hours; 420 ± 45 at 72 hours) in contrast to a decrease in the air group (423 ± 54 at 0 hour; 360 ± 55 at 48 hours; 359 ± 42 at 72 hours).

No significant differences were found in the s-IgA means between the air and SO_2 groups ($p = 0.279$). The s-IgA levels, (expressed in mg/dl), in the SO_2 group, however, remained elevated throughout the post-exposure sampling period (0.455 ± 0.074 at 0 hour; 0.653 ± 0.181 at 24 hours; 0.776 ± 0.220 at 48 hours; 0.619 ± 0.178 at 72 hours).

Conclusions

The data provide some suggestive evidence that exposure to SO_2 may transiently affect the circulatory blood cells and may cause parallel effects on the upper respiratory airways. The data, however, give no information on individual responses nor on the mechanism by which the effect is brought about. This study was performed using young, healthy, male subjects and consequently provides no information on the possible effects of SO_2 on other segments of the population which might be more susceptible to this air pollutant.

It is suggested that future research should include immunologic assays to measure pollutant-induced changes in lymphoid cell numbers and functions which are considered as early indicators of cellular injury. Measurements should be made in populations at risk such as asthmatics using SO_2 combinations with other pollutants to resemble atmospheric conditions. Finally, the follow-up sampling should be extended beyond 72 hours post-exposure period to allow an immunologic response to develop.

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***Shirley Harder** is the EPA Project Officer (see below).*
The complete report, entitled "Hematologic and Immunologic Studies of Humans Exposed to SO_2," (Order No. PB 81-213 381; Cost: $5.00, subject to change) will be available only from:
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